PROFIBUS and PROFINET for Grundfos pumps

CIM/CIU 150 PROFIBUS DP
CIM/CIU 500 Ethernet for PROFINET IO

Functional profile and user manual

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1. Symbols used in this document

Warning

If these safety instructions are not observed, it may result in personal injury.

Caution ***If these safety instructions are not observed, it may result in malfunction or damage to the equipment.***

Note ***Notes or instructions that make the job easier and ensure safe operation.***

2. Introduction

2.1 About this functional profile

This functional profile describes the:

- CIM/CIU 150 PROFIBUS DP
- CIM/CIU 500 Ethernet for PROFINET IO

for the following Grundfos products:

- Grundfos CRE/CRNE/CRIE, MTRE, CHIE, CME
- Grundfos TPE, TPE Series 2000, NBE/NKE
- Grundfos CUE drive
- Grundfos MAGNA (with add-on GENIbus module)
- Grundfos MAGNA3
- Grundfos UPE Series 2000 (UPE 80-120 and 100-120).

In the following, the supported products are referred to as "E-pump".

The data in this document are subject to change without prior notice. Grundfos cannot be held responsible for any problems caused directly or indirectly by using information in this functional profile.

2.2 PROFIBUS DP-V0

The PROFIBUS DP interface conforms to the PROFIBUS DP-V0 standard for cyclic data transmission.

The option of setting the PROFIBUS DP address via bus is not supported as the CIM 150 has two switches for setting the address.

2.3 PROFIBUS DP-V1

Only the diagnostic part and the extra three bytes of parameterisation data are supported. Acyclic data transmission is not supported.

2.4 Assumptions

This functional profile assumes that the reader is familiar with commissioning and programming of PROFIBUS and PROFINET devices.

2.5 Definitions and abbreviations

ARP	Address Resolution Protocol. Translates IP-addresses to MAC-addresses
Auto-MDIX	Ensures that both crossover cable types and non-crossover cable types can be used.
CAT5	Ethernet cable type: Has 4 twisted pairs of wires.
CAT5e	Enhanced CAT5 cable with better performance.
CAT6	Cable with very high performance.
CIM	Communication Interface Module.
CIU	Communication Interface Unit.
CRC	Cyclic Redundancy Check, a data error detection method.
DHCP	Dynamic Host Configuration Protocol. Used to configure network devices so that they can communicate on an IP network.
DNS	Domain Name System. Used to resolve host names to IP addresses.
Enumeration	List of values.
GENIbus	Proprietary Grundfos fieldbus standard.
GENIpro	Proprietary Grundfos fieldbus protocol
Grundfos GO	A Grundfos handheld remote control device for controlling Grundfos products via infrared or radio. Based on smart phone technology.
H	Pressure (head).
HTTP	Hyper Text Transfer Protocol. The protocol commonly used to navigate the world wide web.
IANA	Internet Assigned Numbers Authority.
IP	Internet Protocol
LED	Light-Emitting Diode.
Local mode	The E-pump uses the setpoint and operating mode set with a handheld remote control (R100 or Grundfos GO Remote) or by the use of buttons on the pump.
MAC	Media Access Control. Unique network address for a piece of hardware.
Ping	Packet InterNet Groper. A software utility that tests connectivity between two TCP/IP hosts.
Q	Flow.
R100	Grundfos handheld infrared remote control.
Remote mode	The E-pump uses the setpoint and operating mode set from PROFIBUS.
SELV	Separated or Safety Extra-Low Voltage.
SELV-E	Separated or Safety Extra-Low Voltage with Earth connection.
SMA	SubMiniature version A. Coaxial radio signal cable connection standard.
SMTP	Simple Mail Transfer Protocol
SNTP	Simple Network Time Protocol. Used for clocks synchronization between computer systems.
TCP	Transmission Control Protocol. Protocol suitable for Internet communication and Industrial Ethernet communication.
TCP/IP	Transmission Control Protocol/Internet Protocol. Protocol suitable for Internet communication.
Transmission speed	Bits transferred per second, bits/s.
URL	Uniform Resource Locator. The address used to connect to a server.
UTC	Coordinated Universal Time, the primary time standard by which the world regulates clocks and time.
UTF-8	Unicode Transformation Format (character encoding).
VPN	Virtual Private Network.A network using the Internet to connect nodes. These systems use encryption and other security mechanisms to ensure that only authorised users can access the network and that the data cannot be intercepted.

3. System description

3.1 PROFIBUS/PROFINET

The system diagrams give an overview of how to connect the CIM/CIU 150 or CIM/CIU 500 to the Grundfos E-pump that is to be connected to a PROFIBUS or PROFINET network.

CIM

The CIM module is an add-on communication module that is to be fitted internally in a Grundfos E-pump, using a 10-pin connection. In this setup, the E-pump will supply power to the CIM module. See fig. 1 and fig. 3.

CIU

The CIU unit is a box incorporating a power supply module and a CIM 150/500 module. It can either be mounted on a DIN rail or on a wall. See fig. 2 and fig. 4.
The CIU 150/500 is used in conjunction with a Grundfos E-pump that does not support an internal, add-on communication module (CIM module). The enclosure class is IP54.

3.2 PROFIBUS DP (CIM 150)

Fig. 1 Example of a CIM 150 solution. The CIM module is installed inside the pump. The figure shows a CRE pump.

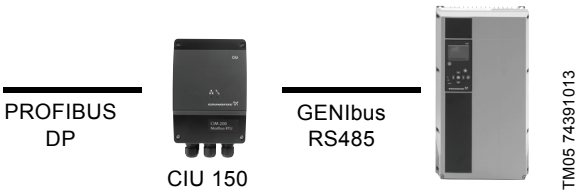

Fig. 2 Example of a CIU 150 solution. The figure shows a CUE-drive for pumps.

3.3 PROFINET IO (CIM 500)

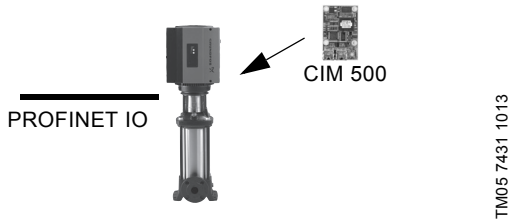

Fig. 3 Example of a CIM 500 solution. The CIM module is installed inside the pump. The figure shows a CRE pump.

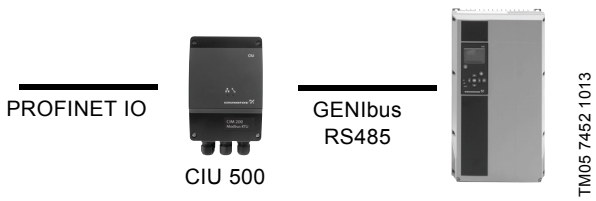

Fig. 4 Example of a CIU 500 solution. The figure shows a CUE-drive for pumps.

4. Specifications

4.1 CIM module general data

General data	Description	Comments
Ambient humidity	30 % to 95 %	Relative, non-condensing.
Operating temperature	-20 °C to +45 °C	
Storage temperature	-25 °C to +70 °C	
GENIbus visual diagnostics	LED2	Will be in one of these states: Off, constantly green, flashing red, constantly red. See section *5.6* for PROFIBUS DP and section *6.5* for PROFINET IO.
Power supply (CIU)	24-240 V	Located in the CIU.
GENIbus connection type (CIU)	RS-485, 3-wire + screen	Conductors: A, B and Y.
CIU box enclosure class	IP54	
CIU box dimensions (H x W x D)	182 x 108 x 82 mm	

4.2 CIM 150 PROFIBUS DP

The table below provides an overview of the specifications for the Grundfos CIM 150 and CIU 150. For further details, please refer to the specific sections of this functional profile.

General data	Description	Comments
PROFIBUS implementation class	DP-V0	Intelligent pump profile.
PROFIBUS connector	Screw-type terminal	A, B, DGND, VP (+5 V).
PROFIBUS connection type	RS-485, two-wire	Conductors: A, B.
Maximum cable length	100 metres at 12 Mbits/s	Corresponds to 328 feet. See section *5.3.1 Data transmission rates and cable length*.
Slave address	1-126	Set via rotary switches SW3 and SW4. See section *5.4 Setting the PROFIBUS address*.
Line termination	On or off	Set via DIP switches SW1 and SW2. See section *5.5 Termination resistors*. Auto detected
Recommended cable cross sectional cobber area	0.20 - 0.25 mm^2	AWG24 or AWG23
Supported transmission speed	9.6 Kbits/s to 12 Mbits/s	Auto detected.
PROFIBUS visual diagnostics	LED1	Off, constantly green, flashing red, constantly red. See section *5.6 Status LEDs*.
Maximum number of PROFIBUS devices at a physical network segment.	32	Up to 125 devices if repeaters are used (physically segmented network).

4.3 CIM 500 PROFINET IO

The table below provides an overview of the specifications for the Grundfos CIM/CIU 500 Ethernet for PROFINET IO. For further details, please refer to the specific sections of this functional profile.

Modbus TCP specifications	Description	Comments
Application layer	DHCP, HTTP, Ping, FTP, SMTP, SNTP, PROFINET IO	Rotary switch in position 0.
Transport layer	TCP	
Internet layer	Internet protocol V4 (IPv4)	
Link layer	ARP, Media Access Control (Ethernet)	
Ethernet cable	Screened/unscreened, twisted-pair cables, CAT5, CAT5e or CAT6	Supports auto cable-crossover detecting (Auto-MDIX)
Maximum cable length	100 metres at 10/100 Mbits/s	Corresponds to 328 feet.
Transmission speed	10 Mbits/s, 100 Mbits/s	Auto-detected.
Industrial Ethernet protocols	PROFINET IO, Modbus TCP	Selected with rotary switch, section 6.2.

5. PROFIBUS DP, CIM 150 setup

5.1 PROFIBUS bus topology

The PROFIBUS-preferred bus topology is daisy chaining as illustrated in fig. 5. The end devices of a physical bus segment must be terminated (LT = Line Termination). Each device must have a unique physical address [1-126]. Up to 32 PROFIBUS devices can be connected to a bus segment, and by using a repeater another 32 devices can be connected. This can be repeated until the maximum number of addresses are used. Make sure that each device is connected to a proper earth potential.

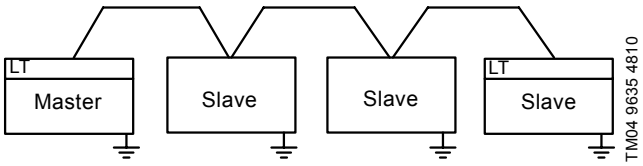

Fig. 5 Example of PROFIBUS bus segment with line termination

5.2 CIM 150 PROFIBUS module

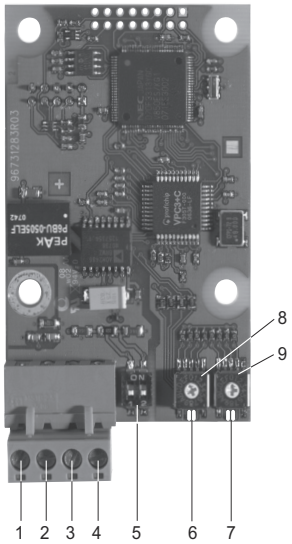

Fig. 6 CIM 150 PROFIBUS module

Pos.	Designation	Description
1	B (RxD/TxD-P)	PROFIBUS terminal B (positive data signal)
2	A (RxD/TxD-N)	PROFIBUS terminal A (negative data signal)
3	DGND	PROFIBUS terminal DGND (only for external termination)
4	VP	+5 VDC (only for external termination)
5	SW1/SW2	On/off switches for termination resistors
6	LED1	Red/green status LED for PROFIBUS communication
7	LED2	Red/green status LED for GENIbus communication between the CIM/CIU 150 and the E-pump
8	SW3	Hex switch for setting the PROFIBUS address (four most significant bits)
9	SW4	Hex switch for setting the PROFIBUS address (four least significant bits)

Note ***The power supply (pos. 4, fig. 6) must only be used for external termination.***

5.3 Connecting the PROFIBUS

5.3.1 Data transmission rates and cable length

Grundfos recommends to use a cable according to IEC 61158.

Example

Siemens, 6XV1 830-0EH10.

Cable length

kbits/s	Maximum cable length [m/ft]
9.6	1200/4000
19.2	1200/4000
45.45	1200/4000
93.75	1000/3300
187.5	1000/3300
500	400/1300
1500	200/660
3000	100/330
6000	100/330
12000	100/330

Fitting the cable

See fig. 7.

1. Connect the red conductor(s) to terminal B (pos. 1).
2. Connect the green conductor(s) to terminal A (pos. 2).
3. Connect the cable screens to earth via the earth clamp (pos. 3).

Note ***For maximum safety and reliability, connect the cable screen to earth via the earth clamp, and make sure that all CIU 150 units are properly earthed via the mains supply earth wire.***

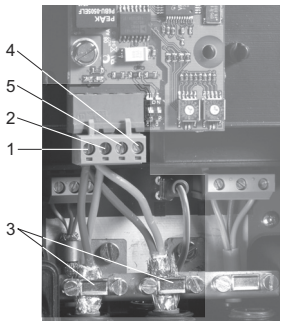

Fig. 7 Connecting the PROFIBUS

Pos.	Description
1	PROFIBUS terminal B
2	PROFIBUS terminal A
3	Earth clamp
4	+5 VDC
5	DGND

5.4 Setting the PROFIBUS address

The CIM 150 PROFIBUS module has two hexadecimal rotary switches for setting the PROFIBUS address. The two switches are used for setting the four most significant bits (SW3) and the four least significant bits (SW4), respectively. See fig. 8.

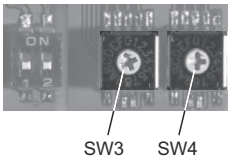

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Fig. 8 Setting the PROFIBUS address

The table below shows examples of PROFIBUS address settings.

Note

The PROFIBUS address must be set decimally from 1 to 126. The address 126 is normally used for special purposes and should not be used.

PROFIBUS address	SW3	SW4
8	0	8
20	1	4
31	1	F
126	7	E

A restart of the CIM/CIU 150 has to be performed for a PROFIBUS address change to take effect.

For complete overview of the PROFIBUS addresses, see section *11. PROFIBUS address*.

5.5 Termination resistors

The termination resistors are fitted on the CIM 150 PROFIBUS module. See fig. 9.

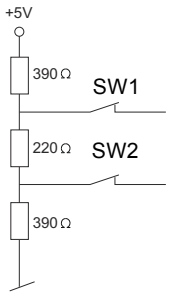

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Fig. 9 Internal termination resistors

The CIM 150 has a DIP switch with two switches (SW1 and SW2) for cutting the termination resistors in and out. Figure 10 shows the DIP switches in cut-out state.

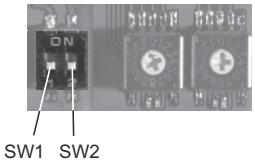

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Fig. 10 Cutting termination resistors in and out

DIP switch settings

Status	SW1	SW2
Cut in	ON	ON
Cut out	OFF	OFF
Undefined state	ON	OFF
	OFF	ON

Note

To ensure stable and reliable communication, it is important that only the termination resistors of the first and last units in the PROFIBUS network are cut in.

5.6 Status LEDs

The CIM 150 PROFIBUS module has two LEDs.

See fig. 6.

- Red/green status LED (LED1) for PROFIBUS communication.
- Red/green status LED (LED2) for GENIbus communication between the CIM/CIU 150 and the connected E-pump.

LED1

Status	Description
Off.	The CIM 150 has been switched off.
Constantly green.	The CIM 150 is ready for PROFIBUS data transmission (Data Exchange State).
Constantly red.	CIM 150 module fault. The CIM 150 does not support the connected E-pump.
Flashing red.	Wrong or missing PROFIBUS configuration or no contact to the PROFIBUS master.

LED2

Status	Description
Off.	The CIM 150 is switched off.
Constantly green.	GENIbus communication between the CIM 150 and the E-pump is OK.
Constantly red.	The CIM 150 does not support the connected E-pump.
Flashing red.	No GENIbus communication between the CIM 150 and the E-pump.

Note

During start-up, there may be a delay of up to 5 seconds before the LED2 status is updated.

5.7 Communication watchdog

The state of the PROFIBUS communication watchdog can be changed with a PROFIBUS commissioning tool, e.g. Siemens Simatic Manager. If the watchdog is enabled, all bits in the ControlModule (see section *7.2 Control module (controlModule, module 2)*) are automatically set to "0" if the PROFIBUS communication is broken.

As a result, the E-pump will be set to local mode and then be operating according to the local operating mode, local setpoint and local control mode.

5.8 Reaction to PLC "Stop button"

If the PLC is stopped by the operator, all output registers will be set to "0".

As a result, the control bit RemoteAccessReq will be cleared, and the E-pump will be set to local mode and then be operating according to the local operating mode, local setpoint and local control mode.

6. PROFINET IO, CIM 500 setup

6.1 Connecting the Ethernet cable

Warning

The CIM 500 must only be connected to SELV or SELV-E circuits.

RJ45 plugs and Ethernet cable must be used. The cable shield must be connected to protective earth at both ends.

Note

It is important to connect cable shield to earth through earth clamp or to connect cable shield to earth in the connector.

The CIM 500 is designed for flexible network installation; the built-in two port switch makes it possible to daisy chain from product to product without the need of additional Ethernet switches. The last product in the chain is only connected to one of the Ethernet ports. Each Ethernet port has its own MAC address.

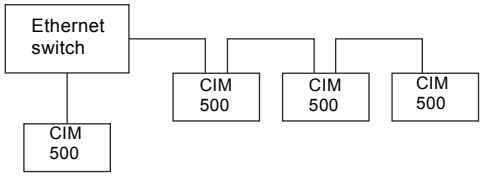

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Fig. 11 Example of Industrial Ethernet network

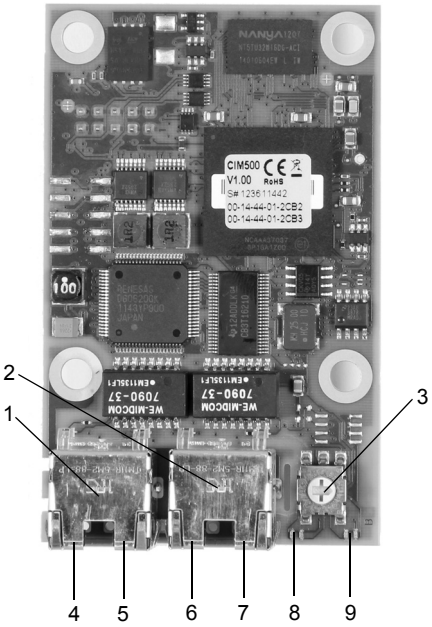

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Fig. 12 Example of Ethernet connection (CIM 500)

Pos.	Description	Designation
1	Industrial Ethernet RJ45 Connector 1	ETH1
2	Industrial Ethernet RJ45 Connector 2	ETH2
3	Rotary switch for protocol selection	SW1
4	Data activity LED for Connector 1	DATA1
5	Link LED for Connector 1	LINK1
6	Data activity LED for Connector 2	DATA2
7	Link LED for Connector 2	LINK2
8	Green/red status LED for Ethernet communication	LED 1
9	Green/red status LED for internal communication between module and pump.	LED 2

6.2 Setting the Industrial Ethernet protocol

The CIM 500 Ethernet module has a rotary switch for selection of the Industrial Ethernet protocol. See fig. 13.

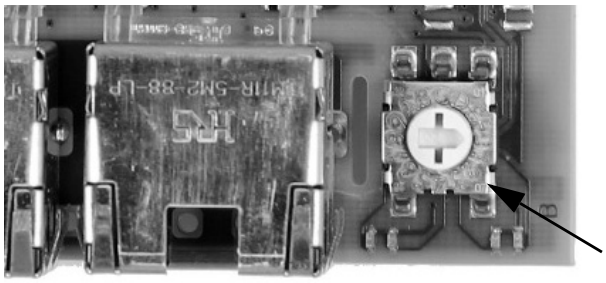

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Fig. 13 Selecting the Industrial Ethernet protocol

Pos.	Description
0	PROFINET IO (Default from factory)
1	Modbus TCP
2..E	Reserved, LED1 will be permanently red to indicate an invalid configuration
F	Reset to factory default Note: The rotary switch has to be set in this position for 20 seconds before the CIM 500 resets to factory default. During this period LED1 will be flashing red and green at the same time to indicate that a reset will occur.

Note

Every change of the rotary switch, when the module is powered on, will cause the module to restart.

6.3 Setting up the IP addresses

The CIM 500 Ethernet module is default set up to a fixed IP address. It is possible to change the IP address settings from the built in web server.

Default IP settings used by web server	IP address:192.168.1.100 Subnet mask: 255.255.255.0 Gateway: 192.168.1.1
IP-settings for Modbus TCP	Must be setup by the Web server
Device name and IP settings for PROFINET IO	Static configuration from Web server or configuration from PROFINET IO configuration tool.

6.4 Establish connection to the Webserver

The CIM 500 module can be configured using the built-in Web server. To establish a connection from a PC to CIM 500 the following steps are required:

- Connect the PC and the CIM 500 module using an Ethernet cable
- Configure the PC Ethernet port to the same subnetwork as the CIM 500, e.g. 192.168.1.101, and the subnet mask to 255.255.255.0. See section *A.2 Web server configuration* on page 28.
- Open a standard Internet browser and type 192.168.1.100 in the URL field.
- Log in to the Web server using:

User	admin (default)
Password	Grundfos (default)

Note ***User and password may have been changed from their factory default values.***

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Fig. 14 CIM 500 connected to PC

Note ***Both ETH1 and ETH2 can be used to establish a connection to the Web server.***

Note ***The web server can be accessed while the selected Industrial Ethernet protocol is active.***

6.5 Status LEDs

The CIM 500 Ethernet module has two Status LEDs, (LED1 and LED2). See fig. 12.

- Red/green status LED (LED1) for Ethernet communication
- Red/green status LED (LED2) for internal communication between the CIM 500 and the Grundfos product.

LED1

Status	Description
Off	The CIM 500 is switched off.
Flashing green	Wink function. LED will flash 10 times when activated from master.
Permanently green	The CIM 500 is ready for data transmission (data exchange state).
Flashing red (3 Hz, duty cycle 50 %)	Wrong or missing PROFINET IO configuration. See section *CIM 500 fitted in a Grundfos E-pump*.
Pulsing red (0.3Hz, duty cycle 10%)	Configured, but connection to master lost. See section *CIM 500 fitted in a Grundfos E-pump*.
Permanently red	Product not supported. See section *CIM 500 fitted in a Grundfos E-pump*.
Permanently red and green	Error in firmware download. See section *CIM 500 fitted in a Grundfos E-pump*.
Flashing red and green	After 20 seconds in this state, the CIM 500 factory settings are restored and the device is restarted.

LED2

Status	Description
Off	The CIM 500 is switched off.
Flashing red	No internal communication between the CIM 500 and the Grundfos product.
Permanently red	The CIM 500 does not support the Grundfos product connected.
Permanently green	Internal communication between the CIM 500 and the Grundfos product is OK.
Permanently red and green	Memory fault.

Note ***During start-up, there is a delay of up to 5 seconds before LED1 and LED2 status is updated.***

6.6 DATA and LINK LEDs

The CIM 500 Ethernet module has two connectivity LEDs related to each RJ45 Connector. See fig. 12.

DATA1 and DATA2

These yellow LEDs indicate data traffic activity.

Status	Description
Yellow off	No data communication on RJ45 Connector.
Yellow flashing	Data communication ongoing on RJ45 Connector.
Steady yellow	Heavy network traffic on RJ45 connector.

LINK1 and LINK2

These green LEDs shows whether the ethernet cable is properly connected.

Status	Description
Green off	No Ethernet Link on RJ45 Connector
Green on	Ethernet Link on RJ45 Connector is OK

7. Detailed description of data modules

7.1 Data types

The Grundfos CIM 150/500 supports the following data types.

All data types, except for data type 10, comply with specification IEC 61158-6 standard data types for use in PROFIBUS/ PROFINET profiles.

Data type	Description
1	Boolean
2	Integer 8
3	Integer 16
4	Integer 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
8	Floating point
9	Visible string
10	Non-standard

All multi-byte data types are transmitted with MSB (Most Significant Byte) first.

7.2 Control module (controlModule, module 2)

The control module is a PROFIBUS/PROFINET output module used for the control of E-pumps. Its data type is 10, non-standard.

Byte	Bit	Name	Event trigger
Byte 1 (data type 5)	0	RemoteAccessReq	State
	1	OnOff	State
	2	ResetFault	Rising edge
	3	-	-
	4	CopyToLocal+	State
	5-7	-	-
Byte 2 (data type 5)		**ControlMode** [enumeration]	
		0: ConstSpeed	
		1: ConstFreq	
		2: -	
		3: ConstHead	
		4: ConstPressure	
		5: ConstDiffPress	
		6: VarDiffPress	
		7: ConstFlow	
		8: ConstTemp	
		9: ConstTempDiff	
		10: ConstLev	
		11-127: -	
		128: $AUTO_{ADAPT}$ (AutoPressMode)**	
		129: $FLOW_{ADAPT}$*	
		130: Closed loop sensor	
Byte 3 (data type 5)		**OperatingMode** [enumeration]	
		0: AutoControl	
		1-3: -	
		4: OpenLoopMin	
		5: -	
		6: OpenLoopMax	
Byte 4 and 5 (data type 6)		Setpoint [0.01 %]	

\+ CUE frequency converter, MGE model H/I and MAGNA3 only.

* MAGNA3 and LME series 2000 only.

** MAGNA and LME series 2000 only.

7.2.1 Explanation to event trigger

Rising edge

Control bits with a rising-edge event trigger behave like a command that is executed when a bit transition from "0" to "1" occurs. Each of them has a corresponding acknowledge bit in the StatusModule which is set when the command is executed and cleared when the control bit is written back to "0".

State

Control bits with a state event trigger behave like a "state" that is forced upon the E-pump. In the CIM/CIU, the "actual state" of the E-pump as read from the StatusModule is continuously compared with the "requested" state in the ControlModule, and the CIM/CIU writes the appropriate GENIbus command to the E-pump to make the two states correspond to each other. Due to state restrictions or priorities, this might not always be possible (see explanation to the bit in question).

7.2.2 Explanation to control bits

RemoteAccessReq

Control bit for setting the E-pump in remote mode (controlled from bus) or local mode (controlled from panel/R100/ Grundfos GO):

0:	The E-pump will be set to local mode and operate according to its local operating mode, setpoint and control mode. With this setting, the other control bits in the ControlModule will have no influence.
1:	The E-pump will be set to remote mode and operate according to the operating mode, setpoint and control mode set in the ControlModule. The other control bits in the ControlModule will also be active.

However, certain commands from other control sources (e.g. Stop or Max. from a local source or external Stop from a digital input) have higher priority and will overrule the control from the bus. The AccessMode bit in StatusModule will have the value "0" if this is the case. See section *7.3.1 Explanation to status module*.

OnOff

Control bit used to start and stop the E-pump:

0:	For stopping the E-pump remotely.
1:	For starting the E-pump remotely.

ResetFault

Control bit that resets alarms and warnings.

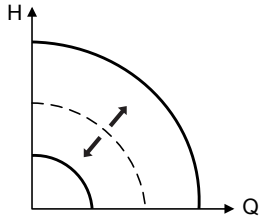
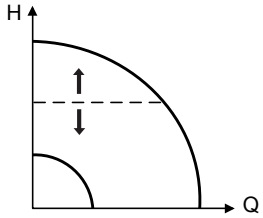
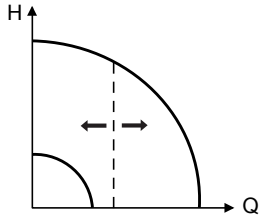
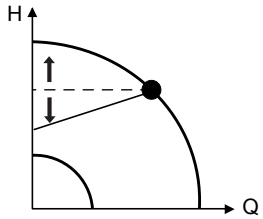
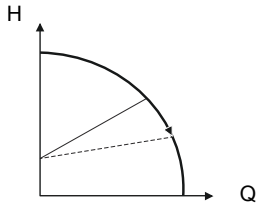
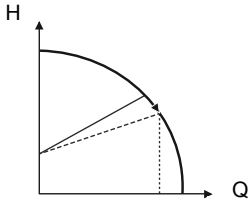
CopyToLocal

Control bit for making the E-pump copy its remote setting of operating mode, setpoint and control mode to its local settings. Whenever this bit is set, switching the E-pump from remote to local (i.e. like the PROFIBUS/PROFINET watchdog does) will not influence the behaviour of the E-pump.

0:	Copy to local settings inactive.
1:	Copy to local settings active.

7.2.3 Explanation to control mode

Control enumeration for selection of the remote control mode.

Control modes	Description	Illustration
> ConstSpeed (0) > ConstFreq (1)	The setpoint of the E-pump is a percentage of the maximum performance. No sensor is required, and in these modes the E-pump is operating in open-loop control.	 TM04 2289 2208
> ConstHead (3) > ConstPressure (4) > ConstDiffPresure (5)	The setpoint of the E-pump will be interpreted as setpoint for the pressure. In these modes, the E-pump is operating in closed-loop control and will adapt its speed so that the pressure is constant, regardless of the flow. A pressure sensor is required.	 TM04 2290 2208
> ConstFlow (7) > ConstTemp (8) > ConstLev (10)	The setpoint of the E-pump will be interpreted as setpoint for the flow, temperature or level. ConstFlow is indicated in the figure. In these modes, the E-pump is operating in closed-loop control, and a relevant sensor is required: • a temperature sensor for temperature control • a level sensor for level control • a flow sensor for flow control.	 TM04 2288 2208
> VarDiffPress (6)	The setpoint of the E-pump will be interpreted as a proportional-pressure setpoint as shown in the figure. This is a closed-loop control mode, and a pressure sensor is required.	 TM04 2291 2208
> AUTO$_{ADAPT}$ (128)	In this control mode, the setpoint curve is a proportional-pressure curve where the setpoint has been set from factory. The AUTO$_{ADAPT}$ algorithm in the pump will over time optimise the setpoint value according to the pipe characteristics of the system. The setpoint curve will always be adjusted in a downward direction.	 TM05 3241 1012
> FLOW$_{ADAPT}$ (129)	This control mode works similar to AUTO$_{ADAPT}$, except that the flow-limiting function, FLOW$_{LIMIT}$, is always active and limits the flow to the value ActualMaxFlowLimit (data module 46).	 TM05 3242 1012
> Closed loop sensor	This is a general purpose closed loop control mode, that can be used in cases where the pump is used for a type of control not covered by one of the other control modes.	

H = Pressure (head)

Q = Flow

Important notes to control mode

Only valid control modes will be accepted. Not all control modes are supported for all E-pump types. If not supported, the resulting control mode, as read from the StatusModule(module 1) will remain equal to the last valid control mode set via PROFIBUS/ PROFINET.

7.2.4 Explanation to operating mode

Control enumeration for selection of the remote operating mode.

0:	AutoControl This is the normal mode. The E-pump is controlled according to the selected control mode and setpoint. See section *7.2.3 Explanation to control mode*.
4:	OpenLoopMin The E-pump operates at a fixed minimum frequency.
6:	OpenLoopMax The E-pump operates at a fixed maximum frequency.

7.2.5 Explanation to Setpoint

Closed loop

The 16-bit data item Setpoint accepts values ranging from 0-10000 corresponding to 0-100 % of feedback sensor maximum value.

This is illustrated in fig. 15.

The Setpoint can represent speed, pressure, flow, etc., depending on the selected control mode which must match the selected sensor.

A setpoint of 0 does not imply a stop.

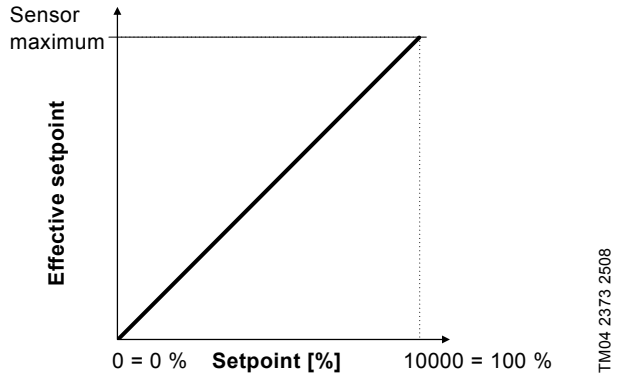


Fig. 15 Closed-loop Setpoint

Example of closed loop

If the control mode is set to ConstPress, and the pressure sensor range is 0-10 bar, a setpoint of 80 % will result in an effective setpoint of 8 bar.

If the sensor range was 0-16 bar, a 50 % setpoint would be 8 bar, a 25 % setpoint would be 4 bar, and so on.

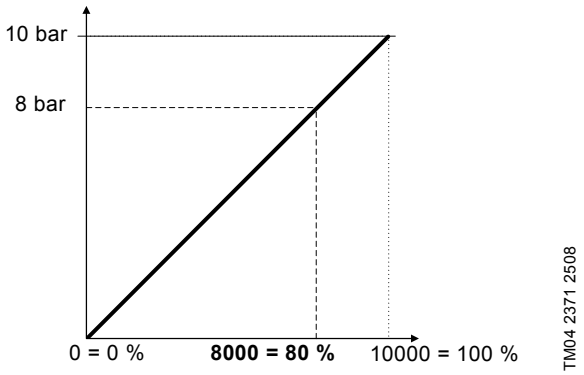


Fig. 16 Example of setpoint for constant pressure, with a pressure sensor range of 0-10 bar

Open loop

The 16-bit data item Setpoint accepts values ranging from 0-10000 corresponding to 0-100 % of the E-pump performance (frequency).

Note

Some E-pump types have a configurable maximum frequency limit. If this limit has been set to a value lower than the frequency stated on the nameplate, a performance of 100 % cannot be attained.

Example of open loop

If the control mode is set to ConstFreq, the setpoint is interpreted as setpoint for the E-pump performance.

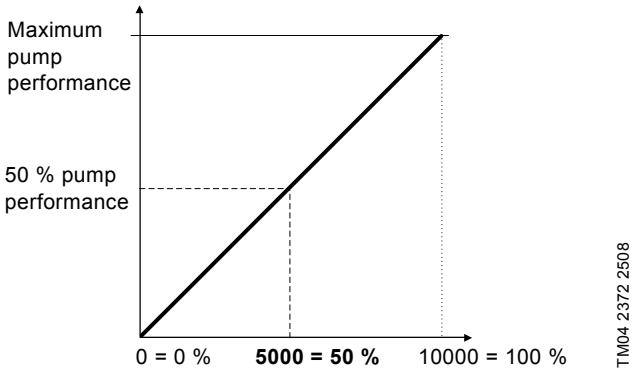


Fig. 17 Example of setpoint for constant frequency

7.3 Status module (StatusModule, module 1)

The status module is an input module used for reading status from E-pumps. Its data type is 10, non-standard.

Byte	Bit	Name
Byte 1 (data type 5)	0	AccessMode
	1	OnOff
	2	Fault
	3	Warning
	4	-
	5	AtMaxSpeed
	6	-
	7	AtMinSpeed
Byte 2 (data type 5)	0-2	-
	3	ResetFaultAck
	4	SetPointInfluence
	5	AtMaxPower*
	6	Rotation
	7	Direction
Bytes 3 and 4 (data type 6)		ProcessFeedback [0.01%]
Byte 5 (data type 5)		**ControlMode** [enumeration] 0: ConstSpeed 1: ConstFreq 2: - 3: ConstHead 4: ConstPressure 5: ConstDiffPress 6: VarDiffPress 7: ConstFlow 8: ConstTemp 9: ConstTempDiff 10: ConstLevel 11-127: - 128: $AUTO_{ADAPT}$ ** (AutoPressMode) 129: $FLOW_{ADAPT}$* 130: Closed loop sensor
Byte 6 (data type 5)		**OperatingMode** [enumeration] 0: AutoControl 1-3: - 4: OpenLoopMin 5: - 6: OpenLoopMax

* MAGNA3 and LME series 2000 pumps only.

** MAGNA and LME series 2000 pumps only.

7.3.1 Explanation to status module

AccessMode

Status bit indicating whether the E-pump is controlled from the bus or from some other control source.

0:	The E-pump is controlled from a local source (buttons, R100, Grundfos GO) or from an external digital input.
1:	The E-pump is controlled from PROFIBUS/PROFINET (remotely).

To allow the E-pump to be controlled from the bus, the RemoteAccessReq control bit in the ControlModule must be set to "1". However, certain commands from other control sources (e.g. Stop or Max. from a local source or external Stop from a digital input) have higher priority and will set the AccessMode to "0", indicating that the actual control source is not the bus.

OnOff

Status bit indicating whether the E-pump is started or stopped.

0:	The E-pump is stopped.
1:	The E-pump is started.

The E-pump can be started/stopped from the busby using the OnOff control bit in the ControlModule.

"Started" does not necessarily indicate that the E-pump is pumping as it might be in a "low-flow stop" condition.

Fault

Status bit indicating that the E-pump has been stopped due to an alarm.

0:	No alarm.
1:	Alarm. E-pump stopped, red pump LED on, FaultCode (module 5) will show the alarm code.

Warning

Status bit indicating that the E-pump has a warning.

0:	No warning.
1:	Warning. WarningCode (module 4) will show the warning code.

AtMaxSpeed

Status bit indicating that the E-pump is running at maximum speed.

0:	The E-pump is not running at maximum speed.
1:	The E-pump is running at maximum speed.

AtMinSpeed

Status bit indicating that the E-pump is running at minimum speed.

0:	The E-pump is not running at minimum speed.
1:	The E-pump is running at minimum speed.

ResetFaultAck

Acknowledge bit belonging to the ResetFault control bit. It will be set when the control bit is set and the command has been executed. It will be cleared when the control bit is cleared.

SetPointInfluence

Status bit indicating if the setpoint is influenced (e.g. by analog input or by temperature). If influenced, the ActualSetpoint (module 29) will differ from the UserSetpoint (module 37).

0:	No setpoint influence.
1:	The setpoint is influenced.

AtMaxPower

Status bit indicating that the E-pump is running at maximum power limit.

0:	The E-pump is not running at maximum power limit.
1:	The E-pump is running at maximum power limit.

Rotation

Status bit indicating that the motor is rotating (consuming power).

0:	No rotation.
1:	Rotation.

Direction

Status bit indicating the direction of rotation of the E-pump.

0:	Clockwise (CW).
1:	Counter-clockwise (CCW).

ProcessFeedback

In closed-loop control, this is the value of the controlled process variable (feedback/primary sensor). The process variable can always be compared directly with the ActualSetpoint variable. If no setpoint influence is active, it can also be compared with the Setpoint variable in the ControlModule.

In open-loop control, Setpoint is mapped to ProcessFeedback. The value of the feedback sensor can be read in the corresponding measurement module. See section *7.9 Measurement data modules*

ControlMode

Status enumeration showing the actual E-pump control mode.

See section *7.2.3 Explanation to control mode* for detailed explanation to the various control modes.

OperatingMode

Status enumeration showing the actual E-pump operating mode.

See section *7.2.4 Explanation to operating mode* for detailed explanation to the various operating modes.

7.4 Illustration of closed-loop control

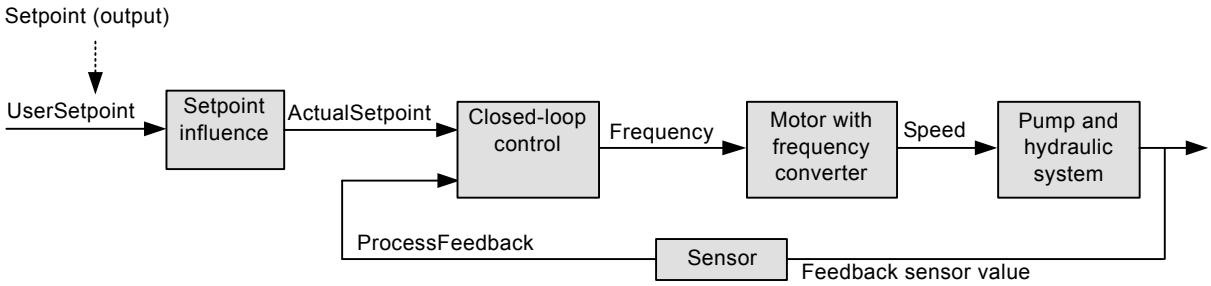


Fig. 18 Illustration of closed-loop control and the associated data modules

7.5 Relay control module (RelayControl, module 3)

This module can control the electromechanical relays in the E-pump if they are configured via a Grundfos PC Tool to be bus-controlled.

Only available for MGE-based pumps.

Bit	Name	Event trigger	Description
0	OutputRelay1Control	State	0: Relay inactive. 1: Relay active.
1	OutputRelay2Control	State	

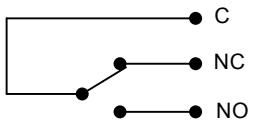


Fig. 19 Relay output shown in inactive state

7.6 Setting of the maximum flow limit (SetMaxFlowLimit, module 44)

This is an output module used to adjust the maximum flow limit of the pump.

The pump flow will be limited by the maximum flow limit in any control mode if the $FLOW_{LIMIT}$ function has been enabled on the pump. The actual value of this limit can be read from ActualMaxFlowLimit (module 46).

Only MAGNA3 and LME series 2000 supports the $FLOW_{LIMIT}$ function.

7.7 Setting of the real-time clock (SetRealTimeClock, module 45)

This is an output module used to set the internal real-time clock of the pump. The format of the clock value is Unix Time format. It is not possible to read the actual value of the real-time clock.

Only E-pumps with a graphical display supports a built-in real-time clock.

The real-time clock is used for time stamping of alarms, warnings and internal data logging. It has a built-in battery back-up. If the power supply to the pump is switched off, the real-time clock will keep running and a new setting is not required.

7.8 Alarms and warnings

Module	Name	Description
4	WarningCode	Code for E-pump warning.
5	FaultCode	Code for E-pump alarm.

In the WarningCode module, the cause of an E-pump warning can be read. A warning has no influence on the E-pump operation.

In the FaultCode module, the cause of an E-pump alarm can be read. An E-pump alarm will always lead to a reaction in the E-pump operation, usually the E-pump will be stopped, but some alarms in some E-pump types have programmable alarm action types.

The complete list of possible alarm/warning codes is shown below.

Code	Alarm/warning description
1	Leakage current
2	Missing phase
3	External fault signal
4	Too many restarts
7	Too many hardware shutdowns
14	Electronic DC-link protection activated (ERP)
16	Other
30	Change bearings (specific service information)
31	Change varistor(s) (specific service information)
32	Overvoltage
40	Undervoltage
41	Undervoltage transient
42	Cut-in fault (dV/dt)
45	Voltage asymmetry
48	Overload
49	Overcurrent (i_line, i_dc, i_mo)
50	Motor protection function, general shutdown (MPF)
51	Blocked motor/pump
54	Motor protection function, 3 sec. limit
55	Motor current protection activated (MCP)
56	Underload
57	Dry running
60	Low input power
64	Overtemperature
65	Motor temperature 1 (t_m or t_mo or t_mo1)
67	Temperature too high, internal frequency converter module (t_m)
70	Thermal relay 2 in motor (e.g. thermistor)
72	Hardware fault, type 1
73	Hardware shutdown (HSD)
76	Internal communication fault
77	Communication fault, twin-head pump
80	Hardware fault, type 2
83	Verification error, FE parameter area (EEPROM)
85	Verification error, BE parameter area (EEPROM)
88	Sensor fault
89	Signal fault, (feedback) sensor 1
91	Signal fault, temperature 1 sensor
93	Signal fault, sensor 2
96	Setpoint signal outside range
105	Electronic rectifier protection activated (ERP)
106	Electronic inverter protection activated (EIP)
148	Motor bearing temperature high (Pt100) in drive end (DE)
149	Motor bearing temperature high (Pt100) in non-drive end (NDE)
155	Inrush fault
156	Communication fault, internal frequency converter module
161	Sensor supply fault, 5 V
162	Sensor supply fault, 24 V
163	Measurement fault, motor protection
164	Signal fault, Liqtec sensor
165	Signal fault, analog input 1
166	Signal fault, analog input 2
167	Signal fault, analog input 3
175	Signal fault, temperature 2 sensor (t_mo2)
176	Signal fault, temperature 3 sensor (t_mo3)
190	Limit exceeded, sensor 1
191	Limit exceeded, sensor 2
240	Lubricate bearings (specific service information)
241	Motor phase failure
242	Automatic motor model recognition failed

7.9 Measurement data modules

This is input data modules representing measurement data that can be read from the E-pump.

Table legend

3ph.: 3-phased only.

CUE: CUE only.

MGE: Pumps with MGE motor only.

G: Only available on model G and later versions.

H: Only available on model H and later versions.

S: Sensor required.

●: Always available.

*: If the E-pump is a TPE Series 2000, the value is estimated and always available.

Module	Name	Description	Data type	Unit	0.25-7.5 kW	11-22 kW + CUE	MAGNA/UPE
6	VolumeFlow	Provides the flow through the E-pump as estimated or measured.	8	m^3/h	S*	S*	●
7	RemoteFlow	Provides the measured flow at an external flow sensor. This flow sensor must be installed for this value to be valid.	8	m^3/h	G + S	S	-
8	RelativePerformance	Provides the performance of the E-pump relative to its maximum performance level.	8	%	●	●	●
9	Head	Provides the pressure/head delivered by the E-pump.	8	bar	S	S	●
10	InletPressure	Provides the inlet pressure if a pressure sensor is configured and installed at the inlet.	8	bar	G + S	S	-
11	RemotePressure1	Provides the measured pressure at an external pressure sensor.	8	bar	G + S	S	3 + S
12	FeedTankLevel	Provides the tank level. Requires that a level sensor is installed.	8	m	H + S	S	-
13	DCLinkVoltage	Provides the DC Link voltage of the frequency converter of the E-pump.	8	V	●	●	●
14	MotorCurrent	Provides the E-pump motor current.	8	A	●	●	3
15	MotorVoltage	Provides the phase-to-phase voltage of the E-pump motor.	8	V	●	●	-
16	Power	Provides the actual power consumed by the E-pump motor.	8	W	●	●	●
17	Energy	Provides the accumulated electric-energy consumption of the E-pump.	8	Wh	●	●	●
18	SpecificEnergyConsumption	Provides the specific energy consumption if a flow is available.	8	Wh/m^3	H + S	CUE + S	3
19	PowerElectronicTemp	Provides the temperature in the frequency converter of the E-pump motor.	8	°C	●	●	-
20	MotorTemp	Provides the E-pump motor winding temperature.	8	°C	G + S + 3ph	S	-
21	RemoteTemp1	Provides the temperature measured by a remote temperature sensor.	8	°C	S	S	3 + S
22	ElectronicTemp	Provides the E-pump electronics temperature.	8	°C	H	MGE	3
23	PumpLiquidTemp	Provides the pumped-liquid temperature, e.g. water temperature.	8	°C	G + S	S	●
24	BearingTempDE	Provides the motor bearing temperature in the drive end of the E-pump motor.	8	°C	H + S	S	-
25	BearingTempNDE	Provides the motor bearing temperature in the non-drive end of the E-pump motor.	8	°C	H + S	S	-
26	OperationTime	Provides the total operating hours of the E-pump.	8	h	●	●	●
27	TotalPoweredTime	Provides the total powered-on time of the E-pump.	8	h	●	●	●
28	AuxSensorInput	Provides an auxiliary sensor input for miscellaneous measurements. Requires that a sensor is installed.	8	%	S	S	-

Module	Name	Description	Data type	Unit	0.25-7.5 kW	11-22 kW + CUE	MAGNA/UPE
29	ActualSetpoint	Provides the actual setpoint of the E-pump. This is the setpoint in percent that theE-pump is currently using.	8	%	●	●	●
30	Frequency	Provides the actual control signal (frequency) applied to the E-pump motor.	8	Hz	●	●	●
31	Torque	Provides the E-pump motor torque.	8	Nm	3ph	●	-
32	Speed	Provides the speed of the E-pump in revolutions per minute.	8	rpm	●	●	●
33	NumberOfStarts	Provides the number the E-pump starts.	8	1	●	●	3
34	Volume	Provides the total pumped volume.	8	m^3	H + S*	CUE + S*	3
35	DigitalInput	Provides the status of the external digital inputs. Logical "0": The input is 0 V. Logical "1": The input is 5 V. 0: Digital input 1 1: Digital input 2 2: Digital input 3 3: Digital input 4 4-7: Reserved.	5	Bits	●	●	3
36	DigitalOutput	Provides the status of the external digital outputs. Logical "0": The output is 0 V. Logical "1": The output is 5 V. 0: Digital output 1 1: Digital output 2 2-7: Reserved.	5	Bits	●	●	3
37	UserSetpoint	User setpoint as written from PROFIBUS/PROFINET or selected at E-pump.	8	%	●	●	●
38	FeedBackSensorUnit	Scaling unit for the closed-loop feedback sensor 0: bar 7: m^3/s 14: l/h. 1: mbar 8: l/s 15: l/min. 2: m 9: gpm 16: gal/h. 3: kPa 10: °C 17: gal/s. 4: psi 11: °F 18: ft^3/h. 5: ft 12: % 19: ft^3/min. 6: m^3/h 13: m^3/min 20: ft^3/s.	5	enum	●	●	3
39	FeedbackSensorMin	Minimum value for the closed-loop feedback sensor.	6	Sensor unit	●	●	3
40	FeedbackSensorMax	Maximum value for the closed-loop feedback sensor.	6	sensor unit	●	●	3
46	ActualMaxFlowLimit	Actual value of maximum flow limit.	8	m^3/h	H	-	3
47	DiffPressure	Pressure between E-pump flanges.	8	bar	H + S	-	3
48	OutletPressure	Pressure at the E-pump outlet.	8	bar	H + S	-	-
49	RemotePressure2	Pressure as measured by external pressure sensor.	8	bar	H + S	-	-
50	LoadPct	Motor current load percentage.	8	%	H	-	3
51	RemoteDiffTemp	Provides the differential temperature as measured by a remote differential temperature sensor.	8	°C	H + S	-	-
52	InletDiffPressure	Provides the inlet differential pressure if a differential pressure sensor is installed at the pump.	8	bar	H + S	-	-
53	OutletDiffPressure	Provides the outlet differential pressure if a differential pressure sensor is installed at the pump outlet.	8	bar	H + S	-	-
54	RemoteDiffPressure	Provides the differential pressure as measured by a remote differential pressure sensor.	8	bar	H + S	-	-
55	StorageTankLevel	Provides the storage tank level as measured by a pressure sensor.	8	m	H + S	-	-

Module	Name	Description	Data type	Unit	0.25-7.5 kW	11-22 kW + CUE	MAGNA/UPE
56	RemoteTemp2	Provides the temperature as a measured by a remote temperature sensor.	8	°C	H + S	-	3 + S
57	AmbientTemp	Provides the ambient temperature as measured by a temperature sensor.	8	°C	H + S	-	-
58	HeatEnergyCounter▶	Total accumulated heat energy in pump life time	8	Wh	H + S	-	3 + S
59	HeatPower▶	Actual heat power	8	W	H + S	-	3 + S
60	HeatDiffTemp▶	Differential temperature between forward and return pipe	8	°C	H + S	-	3 + S

▶: The availability of these measurements requires that the data module VolumeFlow (module 6) is available and that a differential temperature measurement is established by one of the below means:

MGE model H/I

- Direct measurement, where an analog or temperature input has been configured to Remote differential temperature
- PumpLiquidTemp (module 23) measured by build in Grundfos sensor and RemoteTemp2 (module 56) measured by analog or temperature input.
- RemoteTemp1 (module 21) and RemoteTemp2 (module 56) measured by analog or temperature input.

MAGNA3

For the calculation an estimated flow value and measurement of the liquid temperature by the build-in temperature sensor is used. Connection of an external temperature sensor is needed for the pump to calculate the needed differential temperature.

Note ***A data value of 0xFFFF indicates "not available".***

Note ***Estimated flow can be used for monitoring purposes only, but it is not recommended for controlling purposes.***

7.10 Sensor-dependent measurements

As appears from the table many of the measurement modules requires a particular sensor to be present.

Because a limited number of sensors are available only a few of the "S" marked data modules will be available simultaneously.

The sections following describe the relation between available PROFIBUS/PROFINET measurement modules and the setup of sensors. The description is split in sections for different pump types, because the approach varies.

Old MAGNA and UPE pump types

- No connection of external sensor possible

MAGNA3

- Connection of temperature sensor and selection of analog input function "Constant temperature control" will make RemoteTemp2 measurement available.
- Connection of pressure sensor and selection of analog input function "Constant pressure control" will make RemotePressure1 measurement available.

CUE and all E-pump types except model H and I

Sensor unit configuration with R100 or Grundfos GO	PROFIBUS/PROFINET data module generated from sensor measurement		
	Feedback sensor (AI1)	**Measuring sensor* (AI2)**	**Measuring sensor** (AI3)**
bar	Head (9) FeedTankLevel(12)+)	Head (9) and FeedTankLevel(12)+) or InletPressure (10)	Head (9) and FeedTankLevel(12)+) or RemotePressure (10)
mbar			
m			
kPa			
psi			
ft			
m^3/h	VolumeFlow (6)	VolumeFlow (6) or RemoteFlow (7)	VolumeFlow (6) or RemoteFlow (7)
m^3/s			
l/s			
gpm			
°C	RemoteTemp1 (21)	PumpLiquidTemp (23)	PumpLiquidTemp (23) or RemoteTemp1 (21)
°F			
%	AuxSensorInput (28)	AuxSensorInput (28)	AuxSensorInput (28)

* CUE and 11-22 kW E-pumps only.

** CUE, 11-22 kW E-pumps and model G only.

+) Only if "m" or "ft" is selected.

E-pump model H and I

Measured parameters Selected from R100 or Grundfos GO display	Analog input AI1, AI2, AI3	Temperature PT100 input T1, T2	Grundfos build in sensor	Grundfos LiqTec sensor	Mapped to PROFIBUS/ PROFINET data module
Pump inlet pressure	●				InletPressure (10)
Pump inlet diff. press	●				InletDiffPressure (52)
Pump outlet pressure	●				OutletPressure (48)
Pump outlet diff press	●				OutletDiffPressure (53)
Pump diff. pressure	●		●		DiffPressure (47)
Remote pressure 1	●				RemotePressure1 (11)
Remote pressure 2	●				RemotePressure2 (49)
Remote diff. pressure	●				RemoteDiffpressure (54)
Feed tank level	●				FeedTankLevel (12)
Storage tank level	●				StorageTankLevel(55)
Pump flow	●				VolumeFlow (6)
Remote flow	●				RemoteFlow (7)
Pumped liquid temp	●	●	●	●	PumpLiquidTemp (23)
Temperature 1	●	●			RemoteTemp1 (21)
Temperature 2	●	●			RemoteTemp2 (56)
Remote diff. temp	●				RemoteDiffTemp (51)
Ambient temperature	●	●			AmbientTemp (57)
Motor bearing temp. BE		●			BearingTempDE (24)
Motor bearing temp. NDE		●			BearingTempNDE (25)
Other parameter	●				AuxSensorInput (28)

7.11 Device identification (DeviceIdentification, module 41)

The data type is 10, non-standard.

Byte	Name/description	
1	**UnitFamily [enumeration]**	**UnitType [enumeration]**
	1: UPE/MAGNA circulator pump	5: UPE, 3-phase 7: MAGNA, 1-phase 9: MAGNA, 1-phase, small 10: MAGNA3
	2: E-pump, 1-phase/3-phase, based on MGE motor or CUE frequency converter	2: MGE, 1-phase 3: MGE, 3-phase 4: MGE, 3-phase, large 5: CUE frequency converter 6: MGE, 3-phase, model G 7: MGE, 3-phase, model H/I
	7: MP 204 motor protector	1: MP 204
	17: Hydro Multi-E model G and earlier models.	1: With 3-phase pumps 2: With 1-phase pumps
	21: Hydro MPC/Control MPC, Hydro Multi-B	1: Hydro MPC/Control MPC, CU 351 2: Hydro Multi-B, CU 323
	25: CR Monitor	1: CR Monitor, CU 351
	26: Dedicated Controls	1: Dedicated Controls, CU 361
	30: Smart Digital Dosing, DDA	1: Smart Digital Dosing, DDA
	39: Hydro Multi-E model H and later models.	1: With 3-phase pumps 2: With 1-phase pumps
2	UnitType [enumeration] According to description above.	
3	UnitVersion [enumeration] Used by Grundfos.	
4	CIMSoftwareVersion [number]	
5	CIMSoftwareRevision [number]	
6	CIMModel [enumeration]	

8. Product simulation

The CIM module can be put in product simulation mode in which case it will generate life-like simulated values of all the PROFIBUS/PROFINET input data modules.

It will thus be possible to connect a PROFIBUS/PROFINET master to a CIU 150 / CIU 500 without this device being connected to a real pump in a real-life system. In an office environment, it can then be verified that communication works and data is being received and handled correctly by the PROFIBUS/PROFINET master application program (e.g. PLC program) before the equipment is installed under real-life conditions.

8.1 CIM 150 Product Simulation

Product simulation mode is entered when the hexadecimal address switch has one of the values shown in the table below:

Address setting (section *5.4*)		**Simulated product**
SW3	SW4	
F	0	Pump profile
F	1	Booster system profile
F	2	CR Monitor profile
F	3	MP 204 motor protector profile
F	4	Digital Dosing DDA profile
F	5	Wastewater system profile

The effective address will be 15 (0x0F).

Only input modules are simulated. The data read has dummy values and no real product functionality is simulated.

8.2 CIM 500 Product Simulation

Product simulation mode is entered via the web server.
See section *A.4 PROFINET IO configuration* on page 29.

9. Fault finding

9.1 CIM/CIU 150

Faults in a CIM 150 PROFIBUS module can be detected by observing the status of the two communication LEDs. See the table below.

9.1.1 LED status

CIM 150 fitted in a Grundfos E-pump

Fault (LED status)	Possible cause	Remedy
1. Both LEDs (LED1 and LED2) remain off when the power supply is connected.	a) The CIM 150 is fitted incorrectly in the E-pump.	Check that the CIM 150 is fitted / connected correctly.
	b) The CIM 150 is defective.	Replace the CIM 150.
2. The LED for internal communication (LED2) is flashing red.	a) No internal communication between the CIM 150 and the E-pump.	Check that the CIM 150 is fitted correctly in the E-pump.
3. The LED for internal communication (LED2) is constantly red.	a) The CIM 150 does not support the connected E-pump.	Contact the nearest Grundfos company.
4. The PROFIBUS LED (LED1) is constantly red.	a) Fault in the CIM 150.	Contact the nearest Grundfos company.
5. The PROFIBUS LED (LED1) is flashing red.	a) Fault in the CIM 150 PROFIBUS configuration.	• Check that the PROFIBUS address (switches SW3 and SW4) has a valid value [1-126]. See section *5.4 Setting the PROFIBUS address*. • Check that the GSD file used is correct. • Check that the PROFIBUS cable has been fitted correctly. See section *5.3 Connecting the PROFIBUS*. • Check that the PROFIBUS termination is correct. See section *5.5 Termination resistors*.

CIM 150 fitted in the CIU 150

Fault (LED status)	Possible cause	Remedy
1. Both LEDs (LED1 and LED2) remain off when the power supply is connected.	a) The CIU 150 is defective.	Replace the CIU 150.
2. The LED for internal communication (LED2) is flashing red.	a) No internal communication between the CIU 150 and the E-pump.	• Check the cable connection between the CIU 150 and the E-pump. • Check that the individual conductors have been fitted correctly. • Check the power supply to the E-pump.
3. The LED for internal communication (LED2) is constantly red.	a) The CIM 150 does not support the connected E-pump.	Contact the nearest Grundfos company.
4. The PROFIBUS LED (LED1) is constantly red.	a) Fault in the CIM 150.	Contact the nearest Grundfos company.
5. The PROFIBUS LED (LED1) is flashing red.	a) Fault in the CIM 150 PROFIBUS configuration.	• Check that the PROFIBUS address (switches SW3 and SW4) has a valid value [1-126]. See section *5.4 Setting the PROFIBUS address*. • Check that the GSD file used is correct. • Check that the PROFIBUS cable has been fitted correctly. • Check that the PROFIBUS termination is correct. See section *5.5 Termination resistors*.

9.2 CIM/CIU 500

Faults in the CIU 500 can be detected by observing the status of the two communication LEDs. See the table below and section *4.3 CIM 500 PROFINET IO*.

9.2.1 LED status

CIM 500 fitted in a Grundfos E-pump

Fault (LED status)	Possible cause	Remedy
1. Both LEDs (LED1 and LED2) remain off when the power supply is connected.	a) The CIM 500 is fitted incorrectly in the Grundfos product.	Check that the CIM 500 is fitted/connected correctly.
	b) The CIM 500 is defective.	Replace the CIM 500.
2. The PROFINET IO LED (LED1) remains off.	a) The protocol selection switch (SW1) has been set in Modbus TCP position	Set the switch to "0".
3. The LED for internal communication (LED2) is flashing red.	a) No internal communication between the CIM 500 and the Grundfos product.	Check that the CIM 500 is fitted correctly in the Grundfos product.
4. The LED for internal communication (LED2) is permanently red.	a) The CIM 500 does not support the Grundfos product connected.	Contact the nearest Grundfos company.
5. The PROFINET IO LED (LED1) is permanently red.	a) Connected Grundfos product is not supported.	Contact the nearest Grundfos company.
	b) Illegal position of protocol switch. (SW1)	Check that the rotary switch SW1 is set to "0".
6. The PROFINET IO (LED1) is flashing red.	a) Fault in the CIM 500 PROFINET IO configuration.	• Check that the right GSDML file is used. Check that PROFINET IO IP address configuration is correct. See section *PROFINET IO configuration* on page *17*. • Check device name in the CIM 500 and PROFINET IO master.
7. The PROFINET IO (LED1) is pulsing red.	a) Connection to master lost.	• Check cables. • Check master is running.
8. LED1 is permanently red and green at the same time.	a) Error in firmware download.	Use the web server to download the firmware again. See section *Firmware update* on page 23.
9. LED2 is permanently red and green at the same time.	a) Memory fault.	Replace the CIM 500.

CIM 500 fitted in a CIU 500

Fault (LED status)	Possible cause	Remedy
1. Both LEDs (LED1 and LED2) remain off when the power supply is connected	a) The CIU 500 is defective.	Replace the CIU 500.
2. The PROFINET IO LED (LED1) remains off.	a) The protocol selection switch (SW1) has been set in Modbus TCP position	Set the switch in position "0".
3. The LED for internal communication (LED2) is flashing red.	a) No internal communication between the CIU 500 and the Grundfos product.	• Check the cable connection between the Grundfos product and the CIU 500. • Check that the individual Conductors have been fitted correctly. • Check the power supply to the Grundfos product
4. The LED for internal communication (LED2) is permanently red.	a) The CIM 500 does not support the Grundfos product connected.	Contact the nearest Grundfos company.
5. The PROFINET IO LED (LED1) is permanently red.	a) Connected Grundfos product is not supported.	Contact the nearest Grundfos company.
	b) Illegal position of protocol switch. (SW1)	Check that the rotary switch SW1 is set to "0".
6. The PROFINET IO (LED1) is flashing red.	a) Fault in the CIM 500 PROFINET IO configuration.	• Check that the right GSDML file is used. • Check that PROFINET IO IP address configuration is correct. See section *6. PROFINET IO, CIM 500 setup*. • Check device name in CIM 500 and PROFINET IO master.
7. The PROFINET IO (LED1) is pulsing red.	a) Connection to master lost.	• Check cables. • Check master is running.
8. LED1 is permanently red and green at the same time	a) Error in firmware download.	Use the web server to download the firmware again.
9. LED2 is permanently red and green at the same time	a) Memory fault.	Replace the CIM 500.

10. Grundfos alarm and warning codes

This is a complete list of alarm and warning codes for Grundfos products. For the codes supported by E-pumps, see section *7.8 Alarms and warnings*.

Code	Description	Code	Description	Code	Description
1	Leakage current	32	Overvoltage	72	Hardware fault, type 1
2	Missing phase	33	Soon time for service (general service information)	73	Hardware shutdown (HSD)
3	External fault signal	35	Gas in pump head, deaerating problem	74	Internal supply voltage too high
4	Too many restarts	36	Discharge valve leakage	75	Internal supply voltage too low
5	Regenerative braking	37	Suction valve leakage	76	Internal communication fault
6	Mains fault	38	Vent valve defective	77	Communication fault, twin-head pump
7	Too many hardware shutdowns	40	Undervoltage	78	Fault, speed plug
8	PWM switching frequency reduced	41	Undervoltage transient	79	Functional fault, add-on module
9	Phase sequence reversal	42	Cut-in fault (dV/dt)	80	Hardware fault, type 2
10	Communication fault, pump	45	Voltage asymmetry	81	Verification error, data area (RAM)
11	Water-in-oil fault (motor oil)	48	Overload	82	Verification error, code area (ROM, FLASH)
12	Time for service (general service information)	49	Overcurrent (i_line, i_dc, i_mo)	83	Verification error, FE parameter area (EEPROM)
13	Moisture alarm, analog	50	Motor protection function, general shutdown (MPF)	84	Memory access error
14	Electronic DC-link protection activated (ERP)	51	Blocked motor/pump	85	Verification error, BE parameter area (EEPROM)
15	Communication fault, main system (SCADA)	52	Motor slip high	88	Sensor fault
16	Other	53	Stalled motor	89	Signal fault, (feedback) sensor 1
17	Performance requirement cannot be met	54	Motor protection function, 3 sec. limit	90	Signal fault, speed sensor
18	Commanded alarm standby (trip)	55	Motor current protection activated (MCP)	91	Signal fault, temperature 1 sensor
19	Diaphragm break (dosing pump)	56	Underload	92	Calibration fault, (feedback) sensor
20	Insulation resistance low	57	Dry running	93	Signal fault, sensor 2
21	Too many starts per hour	58	Low flow	94	Limit exceeded, sensor 1
22	Moisture switch alarm, digital	59	No flow	95	Limit exceeded, sensor 2
23	Smart trim gap alarm	60	Low input power	96	Setpoint signal outside range
24	Vibration	64	Overtemperature	97	Signal fault, setpoint input
25	Setup conflict	65	Motor temperature 1 (t_m or t_mo or t_mo1)	98	Signal fault, input for setpoint influence
26	Load continues even if the motor has been switched off	66	Temperature, control electronics (t_e)	99	Signal fault, input for analog setpoint
27	External motor protector activated (e.g. MP 204)	67	Temperature too high, internal frequency converter module (t_m)	104	Software shutdown
28	Battery low	68	External temperature/ water temperature (t_w)	105	Electronic rectifier protection activated (ERP)
29	Turbine operation (impellers forced backwards)	69	Thermal relay 1 in motor (e.g. Klixon)	106	Electronic inverter protection activated (EIP)
30	Change bearings (specific service information)	70	Thermal relay 2 in motor (e.g. thermistor)	110	Skew load, electrical asymmetry
31	Change varistor(s) (specific service information)	71	Motor temperature 2 (Pt100, t_mo2)	111	Current asymmetry

Code	Description	Code	Description	Code	Description
112	Cos φ too high	167	Signal fault, analog input 3	195	Limit exceeded, sensor 6
113	Cos φ too low	168	Signal fault, pressure sensor	196	Operation with reduced efficiency
120	Auxiliary winding fault (single-phase motors)	169	Signal fault, flow sensor	197	Operation with reduced pressure
121	Auxiliary winding current too high (single-phase motors)	170	Signal fault, water-in-oil (WIO) sensor	198	Operation with increased power consumption
122	Auxiliary winding current too low (single-phase motors)	171	Signal fault, moisture sensor	199	Process out of range (monitoring/ estimation/calculation/control)
123	Start capacitor, low (single-phase motors)	172	Signal fault, atmospheric pressure sensor	200	Application alarm
124	Run capacitor, low (single-phase motors)	173	Signal fault, rotor position sensor (Hall sensor)	201	External sensor input high
144	Motor temperature 3 (Pt100, t_mo3)	174	Signal fault, rotor origo sensor	202	External sensor input low
145	Bearing temperature high (Pt100), in general or top bearing	175	Signal fault, temperature 2 sensor (t_mo2)	203	Alarm on all pumps
146	Bearing temperature high (Pt100), middle bearing	176	Signal fault, temperature 3 sensor (t_mo3)	204	Inconsistency between sensors
147	Bearing temperature high (Pt100), bottom bearing	177	Signal fault, Smart trim gap sensor	205	Level float switch sequence inconsistency
148	Motor bearing temperature high (Pt100) in drive end (DE)	178	Signal fault, vibration sensor	206	Water shortage, level 1
149	Motor bearing temperature high (Pt100) in non-drive end (NDE)	179	Signal fault, bearing temperature sensor (Pt100), general or top bearing	207	Water leakage
152	Communication fault, add-on module	180	Signal fault, bearing temperature sensor (Pt100), middle bearing	208	Cavitation
153	Fault, analog output	181	Signal fault, PTC sensor (short-circuited)	209	Non-return valve fault
154	Communication fault, display	182	Signal fault, bearing temperature sensor (Pt100), bottom bearing	210	High pressure
155	Inrush fault	183	Signal fault, extra temperature sensor	211	Low pressure
156	Communication fault, internal frequency converter module	184	Signal fault, general-purpose sensor	212	Diaphragm tank precharge pressure out of range
157	Real-time clock out of order	185	Unknown sensor type	213	VFD not ready
158	Hardware circuit measurement fault	186	Signal fault, power meter sensor	214	Water shortage, level 2
159	CIM fault (Communication Interface Module)	187	Signal fault, energy meter	215	Soft pressure build-up timeout
160	GSM modem, SIM card fault	188	Signal fault, user-defined sensor	216	Pilot pump alarm
161	Sensor supply fault, 5 V	189	Signal fault, level sensor	217	Alarm, general-purpose sensor high
162	Sensor supply fault, 24 V	190	Limit exceeded, sensor 1 (e.g. alarm level in WW application)	218	Alarm, general-purpose sensor low
163	Measurement fault, motor protection	191	Limit exceeded, sensor 2 (e.g. high level in WW application)	219	Pressure relief not adequate
164	Signal fault, LiqTec sensor	192	Limit exceeded, sensor 3 (e.g. overflow level in WW application)	220	Fault, motor contactor feedback
165	Signal fault, analog input 1	193	Limit exceeded, sensor 4 (e.g. low level in WW/tank filling application	221	Fault, mixer contactor feedback
166	Signal fault, analog input 2	194	Limit exceeded, sensor 5	222	Time for service, mixer

Code	Description	Code	Description	Code	Description
223	Maximum number of mixer starts per hour exceeded	232	Ethernet: Auto-disabled due to misuse	241	Motor phase failure
224	Pump fault (due to auxiliary component or general fault)	233	Ethernet: IP address conflict	242	Automatic motor model recognition failed
225	Communication fault, pump module	234	Back-up pump alarm	243	Motor relay has been forced (manually operated/commanded)
226	Communication fault, I/O module	235	Gas detected	244	Fault, On/Off/Auto switch
227	Combi event	236	Pump 1 fault	245	Pump continuous runtime too long
228	User-defined event	237	Pump 2 fault	246	User-defined relay has been forced (manually operated/ commanded)
229	Water on floor	238	Pump 3 fault	247	Power-on notice (device/system has been switched off)
230	Network alarm	239	Pump 4 fault	248	Fault, battery/UPS
231	Ethernet: No IP address from DHCP server	240	Lubricate bearings (specific service information)		

11. PROFIBUS address

Decimal to hexadecimal conversion table for setting of the PROFIBUS address switches. See section *5.4 Setting the PROFIBUS address*.

PROFIBUS address	SW3	SW4
1	0	1
2	0	2
3	0	3
4	0	4
5	0	5
6	0	6
7	0	7
8	0	8
9	0	9
10	0	A
11	0	B
12	0	C
13	0	D
14	0	E
15	0	F
16	1	0
17	1	1
18	1	2
19	1	3
20	1	4
21	1	5
22	1	6
23	1	7
24	1	8
25	1	9
26	1	A
27	1	B
28	1	C
29	1	D
30	1	E
31	1	F
32	2	0
33	2	1
34	2	2
35	2	3
36	2	4
37	2	5
38	2	6
39	2	7
40	2	8
41	2	9
42	2	A
43	2	B
44	2	C
45	2	D

PROFIBUS address	SW3	SW4
46	2	E
47	2	F
48	3	0
49	3	1
50	3	2
51	3	3
52	3	4
53	3	5
54	3	6
55	3	7
56	3	8
57	3	9
58	3	A
59	3	B
60	3	C
61	3	D
62	3	E
63	3	F
64	4	0
65	4	1
66	4	2
67	4	3
68	4	4
69	4	5
70	4	6
71	4	7
72	4	8
73	4	9
74	4	A
75	4	B
76	4	C
77	4	D
78	4	E
79	4	F
80	5	0
81	5	1
82	5	2
83	5	3
84	5	4
85	5	5
86	5	6
87	5	7
88	5	8
89	5	9
90	5	A

PROFIBUS address	SW3	SW4
91	5	B
92	5	C
93	5	D
94	5	E
95	5	F
96	6	0
97	6	1
98	6	2
99	6	3
100	6	4
101	6	5
102	6	6
103	6	7
104	6	8
105	6	9
106	6	A
107	6	B
108	6	C
109	6	D
110	6	E
111	6	F
112	7	0
113	7	1
114	7	2
115	7	3
116	7	4
117	7	5
118	7	6
119	7	7
120	7	8
121	7	9
122	7	A
123	7	B
124	7	C
125	7	D
126	7	E

Subject to alterations.

The appendix describes the parts of the CIM 500 web server needed for the configuration of a PROFINET IO Ethernet connection. For other CIM 500 web server features, not specifically related to PROFINET IO, see the CIM 500 Installation & Operating instructions.

A.1 How to configure an IP address on your PC

For connecting a PC to the CIM 500 via Ethernet, the PC must be set up to use a fixed (static) IP address belonging to the same subnetwork as the CIM 500.

1. Open "Control Panel".
2. Enter "Network and Sharing Center".
3. Click [Change adapter settings].
4. Right-click and select "Properties" for Ethernet adapter. Typically "Local Area Connection".
5. Select properties for "Internet Protocol Version 4(TCP/IPv4).
6. Select tab "Alternate Configuration".
7. Configure an IP address and subnet mask to be used by your PC. See fig. 20.

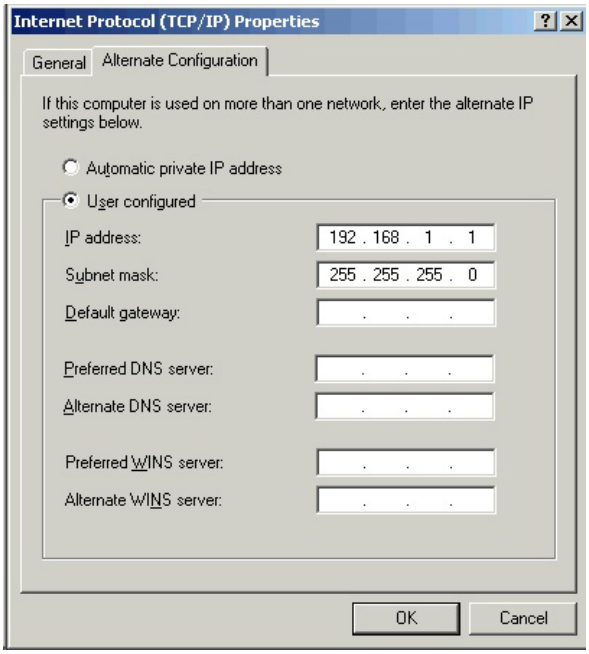


Fig. 20 Example from Windows XP

A.2 Web server configuration

The built-in web server is an easy and effective way to monitor the status of the CIM 500 module and configure the available functions and Industrial Ethernet protocols. The web server also makes it possible to update the firmware of the CIM module, and store/restore settings.

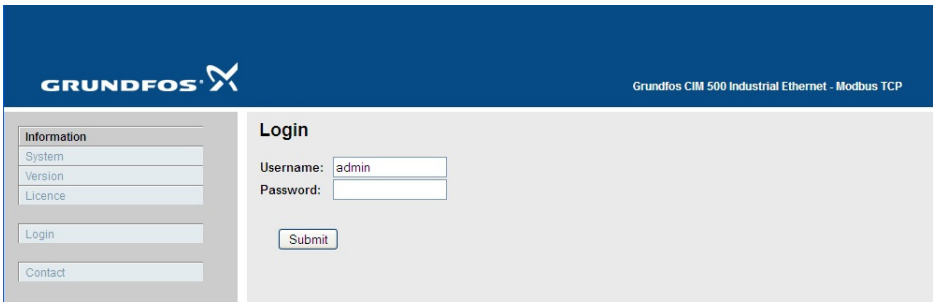
Before configuration

- Check that PC and CIM module are connected via an Ethernet cable.
- Check that the PC Ethernet port is set to the same network as the CIM module. For network configuration, see section *A.1 How to configure an IP address on your PC*.

To establish a connection from a PC to CIM 500 the first time, the following steps are required:

1. Open a standard Internet browser and type 192.168.1.100 in the URL address field.
2. Log in to the Web server.

A.3 Login



TM05 6063 4412

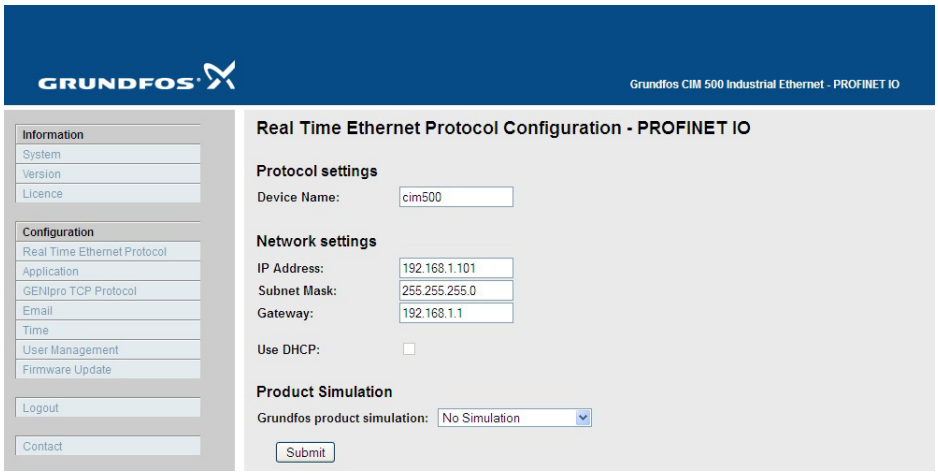
Fig. 21 Login

User name	Enter user name. Default: admin.
Password	Enter password. Default: Grundfos.

Note ***User name and password can be changed on the web server under "Grundfos Management"***

A.4 PROFINET IO configuration

This web page is used to configure all the parameters relevant to the PROFINET IO protocol standard. All settings can also be configured from a standard PROFINET IO configuration tool, for instance Siemens Primary Setup Tool (PST). It is available on internet.



TM05 6065 4412

Fig. 22 Real Time Ethernet Protocol Configuration - PROFINET IO

Object	Description
Device Name	The PROFINET IO device name. It must be unique.
IP Address	The static IP address for CIM 500 on the PROFINET IO network.
Subnet mask	Configure the subnet mask for the CIM 500 module on the PROFINET IO network.
Gateway	Configure the default gateway for the PROFINET IO network.
Use DHCP	The CIM 500 module can be configured to automatically obtain the IP address from a DHCP server on the network.
Grundfos product simulation	The CIM 500 can be put in product simulation mode to generate realistic simulated values of all the PROFINET IO input data modules. It will thus be possible to connect a PROFINET IO master to a CIM 500 fitted in a CIU or E-box without installing this device in a real industrial process system. In an office environment, it can then be verified that communication works and data are received and handled correctly by the PROFINET IO master application program (e.g. PLC program) before installing the device. To enable product simulation, select a product type from the drop down list. Product simulation will be terminated by a module power cycle.

Argentina
Bombas GRUNDFOS de Argentina S.A.
Ruta Panamericana, ramal Campana Centro Industrial Garín - Esq. Haendel y Mozart
AR-1619 Garín Pcia. de Buenos Aires
Pcia. de Buenos Aires
Phone: +54-3327 414 444
Telefax: +54-3327 45 3190

Australia
GRUNDFOS Pumps Pty. Ltd.
P.O. Box 2040
Regency Park
South Australia 5942
Phone: +61-8-8461-4611
Telefax: +61-8-8340 0155

Austria
GRUNDFOS Pumpen Vertrieb Ges.m.b.H.
Grundfosstraße 2
A-5082 Grödig/Salzburg
Tel.: +43-6246-883-0
Telefax: +43-6246-883-30

Belgium
N.V. GRUNDFOS Bellux S.A.
Boomsesteenweg 81-83
B-2630 Aartselaar
Tél.: +32-3-870 7300
Télécopie: +32-3-870 7301

Belarus
Представительство ГРУНДФОС в Минске
220125, Минск
ул. Шафарнянская, 11, оф. 56
Тел.: +7 (375 17) 286 39 72, 286 39 73
Факс: +7 (375 17) 286 39 71
E-mail: minsk@grundfos.com

Bosnia/Herzegovina
GRUNDFOS Sarajevo
Trg Heroja 16,
BiH-71000 Sarajevo
Phone: +387 33 713 290
Telefax: +387 33 659 079
e-mail: grundfos@bih.net.ba

Brazil
BOMBAS GRUNDFOS DO BRASIL
Av. Humberto de Alencar Castelo Branco, 630
CEP 09850 - 300
São Bernardo do Campo - SP
Phone: +55-11 4393 5533
Telefax: +55-11 4343 5015

Bulgaria
Grundfos Bulgaria EOOD
Slatina District
Iztochna Tangenta street no. 100
BG - 1592 Sofia
Tel. +359 2 49 22 200
Fax. +359 2 49 22 201
email: bulgaria@grundfos.bg

Canada
GRUNDFOS Canada Inc.
2941 Brighton Road
Oakville, Ontario
L6H 6C9
Phone: +1-905 829 9533
Telefax: +1-905 829 9512

China
GRUNDFOS Pumps (Shanghai) Co. Ltd.
50/F Maxdo Center No. 8 XingYi Rd.
Hongqiao development Zone
Shanghai 200336
PRC
Phone: +86 21 612 252 22
Telefax: +86 21 612 253 33

Croatia
GRUNDFOS CROATIA d.o.o.
Cebini 37, Buzin
HR-10010 Zagreb
Phone: +385 1 6595 400
Telefax: +385 1 6595 499
www.grundfos.hr

Czech Republic
GRUNDFOS s.r.o.
Čajkovského 21
779 00 Olomouc
Phone: +420-585-716 111
Telefax: +420-585-716 299

Denmark
GRUNDFOS DK A/S
Martin Bachs Vej 3
DK-8850 Bjerringbro
Tlf.: +45-87 50 50 50
Telefax: +45-87 50 51 51
E-mail: info_GDK@grundfos.com
www.grundfos.com/DK

Estonia
GRUNDFOS Pumps Eesti OÜ
Peterburi tee 92G
11415 Tallinn
Tel: + 372 606 1690
Fax: + 372 606 1691

Finland
OY GRUNDFOS Pumput AB
Mestarintie 11
FIN-01730 Vantaa
Phone: +358-(0)207 889 900
Telefax: +358-(0)207 889 550

France
Pompes GRUNDFOS Distribution S.A.
Parc d'Activités de Chesnes
57, rue de Malacombe
F-38290 St. Quentin Fallavier (Lyon)
Tél.: +33-4 74 82 15 15
Télécopie: +33-4 74 94 10 51

Germany
GRUNDFOS GMBH
Schlüterstr. 33
40699 Erkrath
Tel.: +49-(0) 211 929 69-0
Telefax: +49-(0) 211 929 69-3799
e-mail: infoservice@grundfos.de
Service in Deutschland:
e-mail: kundendienst@grundfos.de

HILGE GmbH & Co. KG
Hilgestrasse 37-47
55292 Bodenheim/Rhein
Germany
Tel.: +49 6135 75-0
Telefax: +49 6135 1737
e-mail: hilge@hilge.de

Greece
GRUNDFOS Hellas A.E.B.E.
20th km. Athinon-Markopoulou Av.
P.O. Box 71
GR-19002 Peania
Phone: +0030-210-66 83 400
Telefax: +0030-210-66 46 273

Hong Kong
GRUNDFOS Pumps (Hong Kong) Ltd.
Unit 1, Ground floor
Siu Wai Industrial Centre
29-33 Wing Hong Street &
68 King Lam Street, Cheung Sha Wan
Kowloon
Phone: +852-27861706 / 27861741
Telefax: +852-27858664

Hungary
GRUNDFOS Hungária Kft.
Park u. 8
H-2045 Törökbálint,
Phone: +36-23 511 110
Telefax: +36-23 511 111

India
GRUNDFOS Pumps India Private Limited
118 Old Mahabalipuram Road
Thoraipakkam
Chennai 600 096
Phone: +91-44 2496 6800

Indonesia
PT GRUNDFOS Pompa
Jl. Rawa Sumur III, Blok III / CC-1
Kawasan Industri, Pulogadung
Jakarta 13930
Phone: +62-21-460 6909
Telefax: +62-21-460 6910 / 460 6901

Ireland
GRUNDFOS (Ireland) Ltd.
Unit A, Merrywell Business Park
Ballymount Road Lower
Dublin 12
Phone: +353-1-4089 800
Telefax: +353-1-4089 830

Italy
GRUNDFOS Pompe Italia S.r.l.
Via Gran Sasso 4
I-20060 Truccazzano (Milano)
Tel.: +39-02-95838112
Telefax: +39-02-95309290 / 95838461

Japan
GRUNDFOS Pumps K.K.
Gotanda Metalion Bldg., 5F,
5-21-15, Higashi-gotanda
Shiagawa-ku, Tokyo
141-0022 Japan
Phone: +81 35 448 1391
Telefax: +81 35 448 9619

Korea
GRUNDFOS Pumps Korea Ltd.
6th Floor, Aju Building 679-5
Yeoksam-dong, Kangnam-ku, 135-916
Seoul, Korea
Phone: +82-2-5317 600
Telefax: +82-2-5633 725

Latvia
SIA GRUNDFOS Pumps Latvia
Deglava biznesa centrs
Augusta Deglava ielā 60, LV-1035, Rīga,
Tālr.: + 371 714 9640, 7 149 641
Fakss: + 371 914 9646

Lithuania
GRUNDFOS Pumps UAB
Smolensko g. 6
LT-03201 Vilnius
Tel: + 370 52 395 430
Fax: + 370 52 395 431

Malaysia
GRUNDFOS Pumps Sdn. Bhd.
7 Jalan Peguam U1/25
Glenmarie Industrial Park
40150 Shah Alam
Selangor
Phone: +60-3-5569 2922
Telefax: +60-3-5569 2866

Mexico
Bombas GRUNDFOS de México S.A. de C.V.
Boulevard TLC No. 15
Parque Industrial Stiva Aeropuerto
Apodaca, N.L. 66600
Phone: +52-81-8144 4000
Telefax: +52-81-8144 4010

Netherlands
GRUNDFOS Netherlands
Veluwezoom 35
1326 AE Almere
Postbus 22015
1302 CA ALMERE
Tel.: +31-88-478 6336
Telefax: +31-88-478 6332
E-mail: info_gnl@grundfos.com

New Zealand
GRUNDFOS Pumps NZ Ltd.
17 Beatrice Tinsley Crescent
North Harbour Industrial Estate
Albany, Auckland
Phone: +64-9-415 3240
Telefax: +64-9-415 3250

Norway
GRUNDFOS Pumper A/S
Strømsveien 344
Postboks 235, Leirdal
N-1011 Oslo
Tlf.: +47-22 90 47 00
Telefax: +47-22 32 21 50

Poland
GRUNDFOS Pompy Sp. z o.o.
ul. Klonowa 23
Baranowo k. Poznania
PL-62-081 Przeźmierowo
Tel: (+48-61) 650 13 00
Fax: (+48-61) 650 13 50

Portugal
Bombas GRUNDFOS Portugal, S.A.
Rua Calvet de Magalhães, 241
Apartado 1079
P-2770-153 Paço de Arcos
Tel.: +351-21-440 76 00
Telefax: +351-21-440 76 90

Romania
GRUNDFOS Pompe România SRL
Bd. Biruintei, nr 103
Pantelimon county Ilfov
Phone: +40 21 200 4100
Telefax: +40 21 200 4101
E-mail: romania@grundfos.ro

Russia
ООО Грундфос
Россия, 109544 Москва, ул. Школьная 39
Тел. (+7) 495 737 30 00, 564 88 00
Факс (+7) 495 737 75 36, 564 88 11
E-mail grundfos.moscow@grundfos.com

Serbia
GRUNDFOS Predstavništvo Beograd
Dr. Milutina Ivkovića 2a/29
YU-11000 Beograd
Phone: +381 11 26 47 877 / 11 26 47 496
Telefax: +381 11 26 48 340

Singapore
GRUNDFOS (Singapore) Pte. Ltd.
25 Jalan Tukang
Singapore 619264
Phone: +65-6681 9688
Telefax: +65-6681 9689

Slovenia
GRUNDFOS d.o.o.
Šlandrova 8b, SI-1231 Ljubljana-Črnuče
Phone: +386 1 568 0610
Telefax: +386 1 568 0619
E-mail: slovenia@grundfos.si

South Africa
GRUNDFOS (PTY) LTD
Corner Mountjoy and George Allen Roads
Wilbart Ext. 2
Bedfordview 2008
Phone: (+27) 11 579 4800
Fax: (+27) 11 455 6066
E-mail: lsmart@grundfos.com

Spain
Bombas GRUNDFOS España S.A.
Camino de la Fuentecilla, s/n
E-28110 Algete (Madrid)
Tel.: +34-91-848 8800
Telefax: +34-91-628 0465

Sweden
GRUNDFOS AB
Box 333 (Lunnagårdsgatan 6)
431 24 Mölndal
Tel.: +46 31 332 23 000
Telefax: +46 31 331 94 60

Switzerland
GRUNDFOS Pumpen AG
Bruggacherstrasse 10
CH-8117 Fällanden/ZH
Tel.: +41-1-806 8111
Telefax: +41-1-806 8115

Taiwan
GRUNDFOS Pumps (Taiwan) Ltd.
7 Floor, 219 Min-Chuan Road
Taichung, Taiwan, R.O.C.
Phone: +886-4-2305 0868
Telefax: +886-4-2305 0878

Thailand
GRUNDFOS (Thailand) Ltd.
92 Chaloem Phrakiat Rama 9 Road,
Dokmai, Pravej, Bangkok 10250
Phone: +66-2-725 8999
Telefax: +66-2-725 8998

Turkey
GRUNDFOS POMPA San. ve Tic. Ltd. Sti.
Gebze Organize Sanayi Bölgesi
Ihsan dede Caddesi,
2. yol 200. Sokak No. 204
41490 Gebze/ Kocaeli
Phone: +90 - 262-679 7979
Telefax: +90 - 262-679 7905
E-mail: satis@grundfos.com

Ukraine
ТОВ ГРУНДФОС УКРАЇНА
01010 Київ, Вул. Московська 8б,
Тел.:(+38 044) 390 40 50
Фах.: (+38 044) 390 40 59
E-mail: ukraine@grundfos.com

United Arab Emirates
GRUNDFOS Gulf Distribution
P.O. Box 16768
Jebel Ali Free Zone
Dubai
Phone: +971 4 8815 166
Telefax: +971 4 8815 136

United Kingdom
GRUNDFOS Pumps Ltd.
Grovebury Road
Leighton Buzzard/Beds. LU7 4TL
Phone: +44-1525-850000
Telefax: +44-1525-850011

U.S.A.
GRUNDFOS Pumps Corporation
17100 West 118th Terrace
Olathe, Kansas 66061
Phone: +1-913-227-3400
Telefax: +1-913-227-3500

Uzbekistan
Представительство ГРУНДФОС в Ташкенте
700000 Ташкент ул.Усмана Носира 1-й тупик 5
Телефон: (3712) 55-68-15
Факс: (3712) 53-36-35

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